

To: CALFED Independent Science Board (ISB)

From: John Melack

Re: Modeling activities

The annual meeting of the California Water and Environmental Modeling Forum (CWEMF), held in early March 2004, provided an excellent opportunity to become acquainted with many of the modeling activities relevant to CALFED. Of special relevance to the ISB is a draft report from CWEMF's Committee on Long-term Analytical Tool and Data Development, "Strategic Analysis Framework for Managing Water in California". During conversations with the CWEMF leadership (Nigel Quinn, K.T. Shum and Rich Satkowski) it became apparent that the Forum would gladly engage in collaborative activities with the ISB. In particular, the joint organization and sponsorship of a workshop focused on specific and general aspects of modeling and data assimilation, as indicated by the ISB, is recommended.

To introduce the ISB, its broad mandate and a specific issue, I made a brief presentation to the combined attendees at the CWEMF meeting and the parallel meeting of the Interagency Ecological Program. As requested by the ISB, I raised the following issue in the context of the Delta Improvement Package:

"How well can existing models address the question – will increased pumping lead to management flexibility and better water quality and ecosystem function?"

As a contribution from the CALFED Science Program, Zach Hymanson and Kateri Harrison organized a session called "Advances in Biological Modeling for Fish" to complement the dominance of physical modeling typical of CWEMF. In addition, several presentations in the IEP sessions included modeling of fish. One particularly interesting paper was given by John Nestler; he described an approach that coupled a Eulerian-Lagrangian, individual-based model of fish responding to biotic and physicochemical stimuli. This approach would seem worth evaluation as a way to increase the sophistication of the modeling of fish behavior in the Delta.

Several speakers or activities are especially pertinent to the ISB's efforts to understand the state of modeling, and we should consider obtaining briefings from selected individuals:

During the CWEMF evening program, Maury Roos was awarded their Career Achievement Award, and he provided a personal history of the development of models over the last 44 years including the physical Delta model and the very early analog and digital modeling efforts. Ralph Wurbs' (Texas A&M) keynote address described the development in Texas of the legislatively mandated Water Availability Modeling (WAM) system which is used in their permitting process (www.tnrcc.state.tx.us/permitting).

During the CWEMF Business meeting, Nigel Quinn described the activities of the Model User Groups, the status of peer reviews and the workshops held over the last year. Active User Groups exist for CALSIM, DMS2, IGSM2 and the MIKE system of models. Possible peer reviews for modeling of dissolved oxygen in the Stockton deep-water ship channel or for IGSM2 were discussed. Typically, 4 to 5 workshops each year are run by CWEMF; the workshops are informational and geared toward the public, training for particular models or oriented toward problem-solving.

Saquib Najmus with WRIME outlined trends in integrated hydrologic modeling that are forward-looking and combine data systems with state of the art modeling. His perspective would be valuable to the ISB.

Several presenters described modeling and empirical studies of the dissolved oxygen in the Stockton deep-water ship channel and the Jones Tract levee breach. While sophisticated measurements and hydrodynamic modeling were evident, it was not clear that the key issues were being appropriately addressed. That the widely used Si3D model has not been properly peer-reviewed is a concern. CWEMF did conduct a rigorous, but controversial, peer review of three 1-D models, and there may be value in further review using real-world problems.

Throughout the meeting, water quality usually meant salinity or conductance, and occasionally included dissolved oxygen or dissolved organic carbon. There appears to be a real need to incorporate biogeochemical models that consider a much wider range of constituents into the CALFED domain. Such models exist, and it would seem their implementation should be evaluated.

Most of the models discussed appeared to be open access. However, several, such as the MIKE system and the RMA model, are not. This is an important issue, especially because of the strong pressure to make the CALFED process as transparent as possible.

Validation and sensitivity analysis uncertainty continue to be a challenge for the complex simulation models widely used in CALFED. These issues did not seem to be a focus of the CWEMF, but are well known to the participants.

One development of the ISB's association with CWEMF is the potential for joint sponsorship of a peer review of the CALSIM II San Joaquin Package.

In response to the Science program's 2004 PSP over 20 proposals incorporated model as their primary approach. As these are still under review, it is not appropriate to evaluate specific proposals, but a summary of the classes of models is a useful guide to the ISB:

Four of the seven biological modeling proposals incorporated "individual-based models" (IBMs) and included an age-structured bioenergetic IBM and particle-tracking IBM for Delta smelt, a recruitment model for Chinook salmon and an IBM model of temperature effects on early stages of Chinook salmon. A bioenergetic avian predation on fish model was proposed.

A variety of approaches were proposed to link biological, chemical and physical (hydrodynamic, hydrologic and climatic) models. Some were quite elaborate and ambitious and other were more conceptual. The more complex ones usually proposed to link existing models of different components of the systems. Often the difficulty of matching time-steps and spatial scales and of conducting validation and sensitivity analyses were not fully considered.

A third class of models focused on management and often included scenarios. One example is the coarse-resolution RAND approach that the ISB was briefed on. Others include decision-support systems for agencies that try to include some science, risk analyses of the Delta's future, and water management scenarios.

To inform the ISB effectively about the state of the model currently in use and those under active development, e.g., those funded as part to the PSP, I recommend that the ISB request a synopsis of each of the main models and a concise statement of their strengths and weaknesses. Based on these materials, I suggest that a workshop be organized in autumn 2005 for a comparative and critical discussion of the ability of the models to address specific management questions.